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Chapter 3. Urban Water Use Efficiency

Water use efficiency is using the least amount of water possible to successfully accomplish tasks. Over the past few decades Californians have made great progress in urban water use efficiency. Once viewed and invoked primarily as a temporary strategy in response to drought or emergency water shortage situation, water use efficiency has become a permanent part of the long-term management of California's water supply. At the individual level, the benefits of water use efficiency may appear small, incremental, or difficult to see; but when Californians act together as a community to conserve water, the cumulative effect is significant and the benefits are widespread.

There are several factors that have contributed to increased water use efficiency; outreach efforts that have increased awareness and changed behaviors, urban water suppliers' implementation of Best Management Practices, plumbing codes requiring more efficient fixtures, the model water efficient landscape ordinance, new technologies in the commercial/industrial sector, and mandates for converting unmetered connections to metered.

However, with tighter environmental constraints on the delta, increasing population, and the necessity of adapting to climate change, even greater efficiencies will be needed, and are achievable. When faced with an increasing demand for water, water agencies can consider options for increasing supplies or reducing demand, or a combination of both, to meet this need. Increasing water supply can be expensive, and can include possible costs of purchasing additional water, capital cost of production and distribution systems, water supply treatment facilities, energy costs, and wastewater treatment facilities. Reducing demand through increased water use efficiency is generally lower cost and quicker to implement.

Because of the importance of water use efficiency, the state legislature has directed urban retail water suppliers to reduce urban per capita water use by 20% by the year 2020. This legislation, The Water Conservation Act of 2009, Senate Bill Number 7 of the 7^{th} Extraordinary session (SBX 7-7), was enacted as part of a five bill package aimed at improving the reliability of California's water supply and restoring the ecological health of the Delta. SBX7-7 had multiple urban and agricultural water use efficiency provisions. The key urban conservation measure established a statewide goal of reducing urban per capita water use 20% by 2020. Meeting this statewide goal of a 20% decrease in demand will result in almost 2 Million Acre Feet (MAF) reduction in urban water use in 2020.

This chapter will present the practices already employed in urban water conservation, as well as describing how further efficiencies can be achieved, and how the goal of 20% reduction by 2020 can be met.

Benefits of Urban Water Use Efficiency

Using water efficiently yields multiple benefits, including:

- Increased reliability of water supplies
- Improved capacity to meet the increasing water demand of California's growing population
- Delayed capital costs for new infrastructure to treat and deliver water
- Reduction in contaminated irrigation runoff to surface waters

- Reduced volume of wastewater, thus reducing capital costs and ongoing treatment costs
- Increased availability of water for surface or groundwater storage in wet years
- Reduced water-related energy demands and associated greenhouse gas emissions
- Reduced diversions from the Bay-Delta.

PLACEHOLDER Box 3-1 Reducing Irrigation Runoff Helps Local Waterways

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

PLACEHOLDER Box 3-2 Climate Change and Water Use Efficiency: The Energy-Water Nexus

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Costs of Implementing Urban Water Use Efficiency

Increasing the supply of water has the same effect on water availability as decreasing the demand for water (through increased efficiency). However, historically reliable methods for increasing supply, such as building new dams for surface storage, or increasing water exports from the Delta, are becoming less certain as California moves into the future. Many water suppliers are turning to other strategies, such as improving efficiency, to meet increasing demand. And as the costs for increasing water supply go up, even the more expensive conservation strategies may become economically viable in the future.

Below are some examples of costs for water use efficiency practices. These costs will vary from supplier to supplier, but are provided here as an illustration of what can be reasonably expected.

Sample Costs of Water Use Efficiency to Water Suppliers per Acre Foot of Water Saved:

- Residential Programs [1, 2, 3, 5, 8]
  - Toilet Rebates: $158 - $475/AF
  - Residential Audits: $236 - $1474/AF
  - Clothes Washer Rebates: $154 - $480/AF
- CII Programs [2, 3, 9, 10]
  - Toilet Rebates: $242 - $1018/AF
  - Urinal Replacement: $320 - $583/AF
  - Pre-Rinse Spray Valves: $78/AF
- Landscape Programs [1, 2, 5, 8]
  - Landscape Audits: $58 - $896/AF
  - Equipment Rebates: $15 - $181/AF
  - Turf Removal: $274 - $717/AF
  - Water Budgets: $10 - $59/AF
- Utility Operations Programs [4, 5]
  - System Audits/Leak Detection: $203-$658/AF

It is conservatively estimated that a well-implemented set of water conservation programs would cost a water supplier an average of $333-$500 per Acre Foot[6.]

There are other important water conservation programs that cannot be quantified as "cost per acre foot of water saved". These include designating and supporting a water conservation coordinator, implementing education and outreach programs, and developing and implementing a water waste prohibition ordinance.

Citations

[1] Urban Water Management Plan, Appendix B, City of Paso Robles, 2010

[2] Urban Water Management Plan, Los Angeles Dept of Water and Power, 2010

[3] Reports on Potential Best Management Practices, CUWCC, 2004, 2005, 2006, 2007

[4] BMP3 Cost Savings Study

[5]Urban Water Management Plan, Marin Municipal Water District, 2010

[6]Transforming Water: Water Efficiency as Stimulus and Long-term Investment, Alliance for Water Efficiency

[7] San Diego's Water Sources: Assessing the Options, Equinox Center, 2010

[8] Urban Water Management Plan City of Sacramento, 2010

[9] http://www.ebmud.com/sites/default/files/pdfs/Pre-Rinse-Nozzle-Spray.pdf

[10] AllianceforWaterEfficiency.org/commercial_dishwash_intro

References

Waste Not, Want Not, Pacific Institute

Urban Water Management Plan, Coachella Valley, 2010

Urban Water Management Plan, Eastern Municipal Water District, 2010

Stormwater Capture: SoCal Water Committee 2012

The Business Case for Water Conservation in Texas, Brown, 2007

Where Will We Get Our Water? Assessing Southern California's Future Water Strategies, Los Angeles County Economic Development Corporation, 2008

EBMUD Conservation Evaluation

Commercial, Institutional, and Industrial Task Force, Water Use Best Management Practices, Report to Legislature, DWR, 2012

PLACEHOLDER Box 3-3 San Diego's Water Sources: Assessing the Options

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Urban Water Use Efficiency Today in California

Demand Management Measures (DMMs) and Best Management Practices (BMPs)

DMMs and BMPs are practices that can be implemented by urban water suppliers to conserve water. They have been the major driving force behind urban water conservation in the State of California.

The Urban Water Management Planning Act placed the DMMs in the water code and required urban water suppliers serving over 3000 connections or over 3000 acre feet of water per year to describe their DMM implementation in their Urban Water Management Plans, which are submitted every five years.

These DMMs were included in the California Urban Water Conservation Council's (CUWCC's) Memorandum of Understanding (MOU), but labeled as Best Management Practices (BMPs). Water agencies that became signatories to the MOU pledged to implement the BMPs to specified levels and to report progress on their BMP implementation biannually to the CUWCC.

Originally the CUWCC BMPs were the same as the Demand Management Measures (DMMs) listed in the Urban Water Management Planning Act. But in 2008 the CUWCC BMPS underwent a significant revision. The BMPs were reorganized as either "Foundational" or "Programmatic" BMPs and renumbered, as reflected in Table 3-1. More details on the revised BMPs can be found at www.cuwcc.org.

The CUWCC BMP revision also provided member agencies three options for complying with the BMP water saving goals. The goals could be met through one of the following three measures:

- performing the specific measures listed in each BMP;
- performing a set of measures which achieves equal or greater water savings, referred to as the Flex Track Menu;
- accomplishing set water savings goals as measured in gallons per capita per day consumption.

In order to be eligible for grant or loan funding from the State of California, an urban water supplier, whether a signatory to the CUWCC MOU or not, must demonstrate that it's efforts in implementing each DMM or BMP will be implemented at the coverage level determined by the CUWCC MOU.

Some of the BMPs provide quantifiable water savings, and others do not. For example, within BMP 3 is the practice of toilet retrofits; replacing a 5 gallon per flush toilet with a 1.6 gallon per flush toilet yields water savings of 3.4 gallons per flush. Contrast that to BMP 2, Education and Information Programs.

While education is critical to conservation and necessary to move people to new behaviors, it is not possible to correlate each educational effort with specific water savings.

PLACEHOLDER Table 3-1 Best Management Practices

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

References

CUWCC MOU

Revised BMPs

Urban Water Management Planning Act

Met Appendices on Water Sense

Save Our Water Campaign

20 x 2020: A New Direction

History

In 2008 the Delta Vision Blue Ribbon Task Force called for improved water use efficiency and conservation in order to reduce exports from the Delta. The Task Force specifically recommended a statewide 20 percent per capita reduction in water use by the year 2020. In response to this recommendation, a 20 x 2020 State Agency Team on Water Conservation was formed. The Agency Team subsequently wrote the 20 x 2020 Water Conservation Plan[1] outlining recommendations on how statewide per capita water use reduction, meeting the goal of 20% reduction by 2020, could be successfully implemented.

In November 2009, The Water Conservation Act of 2009, Senate Bill Number 7 of the 7th Extraordinary session (SBX 7-7)[2], was enacted by the California legislature. The urban water conservation provisions of SBX 7-7 reflect the approach taken in the 20 x 2020 Water Conservation Plan and set an overall goal of reducing per capita urban water use statewide by 20% by 2020.

The SBX 7-7 legislation also directed DWR to address the following urban water use efficiency issues:

- Convene a task force to investigate alternative best management practices for the commercial, industrial and institutional sectors (CII Task Force)
- Establish a standardized water use reporting form
- Promote regional water resource management through increased incentives and decreased barriers
- Develop statewide targets for regional water management practices like recycled water, brackish groundwater, desalination and urban stormwater infiltration and direct use.

The 20 x 2020 Process

Water suppliers play a fundamental role in carrying out the statewide water reduction goal of 20% by 2020. Each supplier over a certain size is required to set water use targets based on their historical water use, the local climate, and locally implemented conservation programs. The statewide goal will be met by combining the water reductions from each water supplier.

The legislation does not require a reduction in the total volume of water used in the urban sector. That is because other factors, such as changes in economics or population, will affect water use. Rather, the legislation requires a reduction in per capita water consumption and is calculated in gallons per capita per day.

As set out in the SBX 7-7 legislation, and using the methodologies and criteria in "Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use", DWR, October 2011, water suppliers:

- must determine their baseline water use and target water uses for 2015 and 2020. Wholesale suppliers are not required to set targets, but are directed to assist their retail suppliers in meeting the targets.
- must report their gross water use during the final year of the reporting period (years 2015 and 2020). This is known as the "Compliance Water Use".
- may revise their baseline water use calculations and change the method used to set their targets after submitting their 2010 UWMPs.

Impact of 20 x 2020

Projecting forward to the year 2020, with statewide population expected to be in the range of 44 million people, a decrease in per capita water use of 20% will equate to an annual demand reduction of 2 million acre feet of water.

The requirement that all urban retail water suppliers quantify per capita baseline water use, set water use targets, and then show actual reductions in 2015 and 2020 has caused suppliers across the state to pay particularly close attention to the effectiveness of their water conservation programs.

Citations

[1] 20x2020 Plan

[2] SBX 7-7

[3] Methodologies for Calculation Baselines and Targets

[4] Delta Vision Strategic Plan, Strategy 4.1 October 2008

Baseline Water Use

The statewide average baseline water use is 198 gallons per capita per day (gpcd). This figure is derived from baselines reported in Urban Water Management Plans from 342 retail water agencies[1]. The time period for the baseline water use is largely from 1996 to 2004, though suppliers could choose any 10 consecutive years from between 1995 and 2010.

Figure 3-1 shows how baseline water use differs regionally across the state. Generally lower water use is seen along the coast and increasing water use in the inland valleys, though low or high per capita water use is not necessarily an indicator of efficiency. Climate and land use factors can have a significant effect on water use. The coastal areas generally use less water in their landscapes because the marine climate provides a lower rate of evapotranspiration and the size of coastal residential landscapes tends to be smaller than inland areas. Increased efficiencies have also been needed on the coast because these communities were strongly impacted in the 1988-92 drought and a number of conservation programs were implemented to improve water supply reliability.

PLACEHOLDER Figure 3-1 Average Regional Baseline Water

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

PLACEHOLDER Figure 3-2 Range of Baseline Water Use Reported by Urban Water Suppliers

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Figures 3-1 and 3-2 display the range of per capita water use reported by the water agencies in their 2010 UWMPs. 15 suppliers had water use below 100 gpcd while four suppliers had water use greater than 1000 gpcd. The 15 suppliers below 100 gpcd were generally near the coast in dense urban environments with smaller landscape areas. The suppliers with higher water use are typically supplying water to homes or ranchettes in suburban or rural areas with large areas of irrigated landscape or pastures.

Water Use by Sector

The total volume of urban water use, statewide, as reported in the California Water Plan, is 8.8 million acre feet (MAF) per year. This is an eight year average for the time period of 1998-2005 [2]. There is some variation in water use reporting between the California Water Plan and 20 x 2020 calculations used in Urban Water Management Plans. When estimating urban water use, Water Plan calculations include the use of recycled water, self supplied industrial water, potable water supplied to agriculture, conveyance losses, and water used for ground water recharge. The 20 x 2020 calculations used in Urban Water Management Plans do not include these urban water uses.

Table 3-2 and Figure 3-3 show the division of the 8.8 MAF of urban water use (as reported in the California Water Plan) into water use sectors. The percentages of water use for each sector are taken from the California Water Plan 2009[1].

PLACEHOLDER Table 3-2 Statewide Urban Water Uses

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

PLACEHOLDER Figure 3-3 Urban Water Use Statewide Average

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

2010 Water Use in Gallons per Capita per Day (GPCD)

The 2010 statewide average water use, as reported in 2010 UWMPs, was xxxx gpcd[2] [still being calculated].

Because of the economic downturn, the 2007-2009 drought, and a cool summer in 2010, many suppliers have reported significant drops in water use in the last few years and some have already met their 2020 water use target. These suppliers are now focused on ways to keep water use low once the economy improves and a more typical weather pattern returns.

Citations

[1] CA water Plan 2009

[2] DWR report to legislature 2010 UMWPs

2015 and 2020 Water Use Targets

Water suppliers reported their 2015 and 2020 per capita water use targets in their 2010 Urban Water Management Plans. The average 2020 target reported was 166 gpcd. This target is a 16.2% reduction from the statewide average baseline of 198 gpcd, which is less than the 20% goal. The legislation provided four methods for calculating the 2020 target and this allowed some suppliers to select targets lower than the 20% goal, but none of the methods require suppliers to select targets higher than 20%.

After receiving the 2015 UWMPs, DWR is required to report to the legislature on progress towards the 20% goal. Suppliers are expected to be half way between the baseline and the 2020 target by 2015. If the state, overall, is not on track to meet the 20% target, DWR is directed to provide recommendations to the legislature on how the goal can be achieved.

A list of the individual water supplier’s baselines and targets and more information on statewide and hydrologic region averages is available in DWR’s report to the legislature on the 2010 Urban Water Management Plans[1].

Citations

[1] DWR Report to Legislature on 2010 UWMPs

Meeting the Targets – Potential Savings by Sector

Since the early 1990's voluntary implementation of BMPs and new codes and regulations have increased water use efficiency in California. However, abundant opportunities still exist to increase urban water use efficiency, and many of these opportunities will need to be tapped in order for California to achieve its 20% reduction goal by 2020. Descriptions of actions that can be taken, and their potential for increased savings, are presented below.

All water savings noted in the following sections are comparisons to the baseline water use reported by water suppliers in their 2010 Urban Water Management Plans. Because baselines and targets are reported in gallons per capita per day (gpcd) the descriptions presented below will state the current water use and potential savings in GPCD.

These opportunities for savings are from a statewide perspective. The savings for an individual water agency will vary depending on their unique local conditions.

Landscape Irrigation

Annual water demand for urban landscape irrigation (residential and large landscapes) amounts to approximately 4 million acre feet, about 43% of urban demand (see Table 3-2 and Figure 3-3). However, water waste from landscapes is common and can often be seen as water running down street gutters, leaks and overspray from broken or misdirected sprinkler heads, and watering during a rainstorm.

Improving landscape irrigation efficiency presents an opportunity for significant water conservation in the state and can be accomplished using a variety of tools, such as, proper irrigation system design, regular system maintenance, adjustments to the irrigation schedule, conducting irrigation audits, use of water budgets, and water efficient landscape design that includes water efficient plants and water retention features, such as swales or rain gardens. Each of these opportunities varies in degree depending on landscape size, local climate, maintenance budgets, and landscape function.

PLACEHOLDER Box 3-4 Landscape Irrigation Runoff

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Landscape irrigation audits and landscape water budgets provide a means to measure irrigation efficiency and indicate where improvements can be made. Monitoring water use and comparing it to a water budget based on landscape area, plant water needs, and local climate is the easiest way to determine if a site is irrigating efficiently. The United States Environmental Protection Agency (EPA) WaterSense[1] program has labeled several certification programs offered in California that instruct and certify landscape professionals in advanced water management and irrigation auditing.

Another effective method for reducing irrigation demand is through selection of low water using plants and a corresponding reduction in water application. Plant choices and landscape styles are driven by economic factors and esthetic concerns. Initially some low water using landscapes may cost more to install, but over time the decreased water and maintenance demands offset the higher installation costs. Esthetic needs are difficult to quantify, but there is increased interest in using California natives, other

Mediterranean climate plants, and desert plants. Research and development by universities and sod producers have led to the introduction of lower water using varieties of turf grasses.

Urban landscapes can be divided into three categories; residential, large landscape, and CII mixed meter. Each of these uses is addressed more specifically below.

PLACEHOLDER Box 3-5 The Value of Landscape Water Budgets

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Residential Landscapes

Outdoor residential water use represents the single largest end use of urban water, accounting for 34% of total urban use[3].

Many factors contribute to the large amount of water used in residential landscapes, including population shifts to hotter interior regions which often have larger residential landscapes[4], the prevalence of cool season turf grasses and other high water use plants, irrigation systems that are inefficient and poorly maintained, and widespread overwatering of all plant types. The routine use of automatic irrigation controllers has been shown to increase water use at single family homes by more than 50% over the use at homes with manually operated irrigation systems[5].

Looking at utility-wide water use patterns, water users irrigating at a rate less than a calculated water budget frequently counterbalance those that apply too much water[6]. It can be assumed that most of those that under irrigate are nevertheless satisfied with the quality and appearance of their landscapes, otherwise those irrigators would have increased their water use. In the report "Evaluation of California Weather-Based "Smart" Irrigation Controller Programs" 41.8 % of sites had an increase in water use over the historical application ratio[7]. This can be attributed to the fact that many landscapes need less water than the theoretical water requirement that the weather based irrigation controllers applied and it is apparent that many landscapes can be maintained at a rate below a calculated water budget of 100% or even 80% of Reference Evapotranspiration (ETo).

There are at least two possible explanations for this phenomenon; either some landscapes require less water than previously thought because of actual plant water needs, soil conditions and cultural factors contribute to a lower demand or the standard used to estimate water requirements needs to be reevaluated. Prior to 2010, landscapes that were installed in compliance with the AB 325 (1990) Model Water Efficient Landscape Ordinance (MWELO) were allowed a water budget that did not exceed an Evapotranspiration Adjustment Factor (ETAF) of 0.8. Currently, the AB 1881 (2006) MWELO water budget for most non-recreational landscapes is calculated with an ETAF of 0.7. In the report "Water Smart Landscapes for California", the AB 2717 Landscape Task Force recommended (Recommendation 12) that the ETAF be reviewed every ten years for possible further reduction[8]. After more research is completed in plant water needs, it may be appropriate to lower the ETAF used in the water budget calculation.

In light of these findings, water suppliers should focus their efforts and resources on water users with high application rates per landscape area[14]. As a marketing tool, a cost benefit analysis based on water rates and other factors can pre-determine which customers would be the best candidates for intervention, both in terms of maximizing water supplier resources and customer buy-in. Furthermore, because most residential users underestimate the quantity of water used in their landscape[9], education components remain a vital tool in that they increase the water savings potential[18].

Several water use studies (*Waste Not, Want Not*, Pacific Institute[10]; *Residential Weather Based Irrigation Scheduling*, Irvine Ranch[11]; *Lawns and Water Demand*, Public Policy Institute[12]; *California Single Family Water Use Efficiency Study*[14]) indicate that residential landscape water demand can potentially be reduced by at least 20%-25% with some researchers estimating savings potential of 45% or more[13].

The baseline rate of residential outdoor water use is estimated at 81 GPCD as follows: baseline residential outdoor use is 3.0 MAF (see Table 3-2), divided by a 2000 population of 33,780,000, then converted to GPCD.

A conservative estimate of 20% reduction would represent a savings of 16.2 GPCD, equating to an annual statewide reduction of 0.79 MAF by 2020.

Large Landscapes (Dedicated Meters)

Large landscapes are CII landscapes that are a category set apart by the presence of dedicated irrigation meters. Dedicated metering serves the purpose of accurately measuring the water use of a landscape and making it possible to assign and monitor water budgets and detect leaks. The CUWCC landscape BMP (formerly BMP 5) requires water use budgets to be assigned at 70% of local ETo. Based on an eight year average of DWR data (see Table 3-1 and Figure 3-3), large landscapes with dedicated meters accounted for 9% of urban water use or .8 MAF. Water use through the dedicated meter can be monitored by the irrigator and can provide immediate feedback on the amount of water moving through the meter. Programs such as the California Landscape Contractors Association (CLCA) Water Management Certification Program[15] enable irrigation managers to monitor and track water use and manage a landscape at 80% of Reference Evapotranspiration (ETo) or less.

PLACEHOLDER Box 3-6 Dedicated Water Meters: Water Code 535

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

The numbers of sites and total acreage of sites designated as large landscapes will increase over time as mixed use meters at existing CII landscapes are retrofitted to dedicated meters. All new CII landscapes over 5000 square feet require a dedicated irrigation meter and are more accurately known as "large landscapes".

A CII Landscape Water Use Efficiency study (CLCA 2003[16]) collected data collected from 449 CII landscapes. The results indicate that approximately 50% of CII landscapes are irrigated at an excess of 100% ETo. If those sites reduced water use to maintain a water budget of 100% ETo, the author estimates a 15% demand reduction can be achieved. Potential landscape efficiency gains could be much greater than 15% if conversions from cool season turf to water efficient plants were included and if the water budget were reduced to 70% or 80% of ETo.

Recent information from the CLCA[17] indicates that numerous sites maintained and managed under the Certified Water Manager program are performing at water budgets of 80% or less. As more landscape professionals adopt advanced water management techniques, water use in the CII and large landscape sectors will continue to decrease.

Baseline water use on large landscapes is estimated at 21 GPCD. Using a conservative estimate of a 15 % reduction (3 GPCD), annual demand reduction by the year 2020 will be approximately 0.15MAF.

Commercial/Industrial/Institutional Landscapes (Mixed Use Meters)

Water use studies indicate that the opportunities for water savings in CII landscapes with mixed use meters are probably as high as residential landscapes; however significant data gaps exist due to inconsistencies in water use reporting. Suppliers voluntarily report their public water supply production and depending on the agency, landscape water use may be included in CII, multi-family or “other” categories.

Landscape Citations

1 EPA Water Sense

2 MWDOC Residential Runoff Reduction

3 California Water Plan 2009

4 PPIC Lawns

5 Splash or Sprinkle

6 California Single Family Home Study

7 Evaluation of CA WBI Smart Irrigation Controllers

8 CUWCC Water Smart Landscapes for Cal

9 Statewide Market Survey: Landscape Water Use Efficiency, 2007, CUWCC

10 Waste Not, Want Not, Pacific Institute

11 IRWD Residential Weather Based Irrigation Scheduling

12 PPIC Lawns and water demand

13 Waste Not , Want Not, Pacific Institute

14 California Single Family Home Study

15 CLCA Water Manager Certification Program

16 CLCA CII landscapes (Whitcomb)

17 CLCA Water Forums 2012

Indoor Residential Water Use

Indoor residential water use (both single and multi-family housing) accounts for about 31% of total urban water use in California (See Figure 3-3 and Table 3-2). This equates to a baseline water use for indoor residential of 62 GPCD (using 8.8 million acre feet for the total annual urban water use[6], and 33,780,000 for the 2000 population).

A comparison of indoor residential water use between California's baseline (62 GPCD) and a 2000 EPA study[1] of homes retrofit with high efficiency fixtures and appliances (37 GPCD) demonstrates that significant savings remain to be captured in this sector.

Residential indoor water is delivered through only a small number of fixtures - toilets, clothes washers, showers, faucets, and dishwashers. The percentage of water use by fixture is displayed in Figure 3-4. The following paragraphs address these fixtures, and potential savings, in more detail.

PLACEHOLDER Figure 3-4 Estimated Current Indoor Residential Water Use in California (Year 2000)

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Toilets

A 1997 study [3] revealed that toilets were the biggest component of indoor water use at that time. Many older, inefficient toilets have been replaced with more efficient models since then, but years later, it appears that toilets are still the largest user of indoor residential water use. More current studies show that toilets account for 20- 33% of indoor water use [4, 2], which equates to an average of 13-19 GPCD.

1992 California code for new toilet sales required increased efficiency from older toilets that used 3.5 or 5 gallons per flush (gpf) to toilets with a flush volume of 1.6 gpf, known as ultra-low flow toilets (ULFTs). In 2014 the code requirement for all toilets - purchased or installed - moves to high efficiency toilets (HET) using 1.28 gpf. However, new construction is required to use HET toilets by 2011, as per the California Green Building Code.

Many existing toilets remain to be converted to efficient models. Estimates are that the saturation of ULFTs and HETs is 54%- 60% [4, 5].

Technical Memorandum 4 of the 20 x 2020 Plan calculates that retrofitting residential toilets, so that 81% are ULFT or HET, could save roughly 5 GPCD.

Clothes Washers

Clothes washers account for 14-17.5% of indoor residential water use [2, 4], which is about 9-10.5 GPCD. However, according to the Single Family Water Use Study[4], only about 20% of homes studied in 2007 were using efficient washers. This indicates that there is great potential for decreasing per capita water use for clothes washing through appliance replacement.

The water efficiency of clothes washers is rated using the term "water factor". The water factor is measured by the quantity of water (gallons) used to wash each cubic foot of laundry. The lower the water factor rating, the more water efficient the clothes washer.

Standards for the water efficiency of residential clothes washers have been put in place by the Department of Energy. These water factor standards have been moving progressively lower over several years. The most current standard will culminate in 2018 with a maximum water factor of 6.5 for standard top-loading machines and 4.7 maximum water factor for standard front loading machines. For comparison, conventional washers have a water factor of 12 to 13.

The 20 x 2020 Plan estimated that potential savings from efficiency codes, active rebate programs, and natural turnover of clothes washers would equal 4-6 GPCD.

Leaks

The Single Family Water Use Study[4] and Waste Not, Want Not [2] reveal that the water lost to leakage in the residential sector averages from 7 to 10 GPCD. This number is relatively large; however the majority of the water loss was concentrated in a small number of homes. The median loss was found to be small, between 1.4 and 3.9 GPCD. Yet 14% of the homes lost over 17 GPCD to leaks, and 7% of the homes were leaking over 34 GPCD. This variability suggests that leak reduction programs targeting homes with the highest leakage rates would be the most cost effective for water suppliers[2, 4].

There are several methods that water suppliers can employ to detect homes with high rates of leakage, including:

- Develop water budgets. Homes with leaks will exceed their water budgets and pay excess use rates, thus encouraging repair.
- Install advanced metering infrastructure (AMI). AMI monitors water usage in real time, sampling hourly to every 15 minute. Because of the frequent monitoring and collection of water use data, a constant flow (leak) can be detected quickly and efficiently.
- Identify excessive water users (by comparison of water bills with similar properties) and offer water audits to these customers.

PLACEHOLDER Box 3-7 City of Sacramento — Case Study: Advanced Metering Infrastructure (AMI)

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

An emerging technology for detecting leaks of end users is Advance Metering Infrastructure (AMI).

If leaks were to be detected and repaired at homes with high leak rates, so that the average loss due to leaks were reduced to the median values (1.4 -3.9 GPCD), the savings would be 6-7.5 GPCD[2, 4].

However, many water suppliers lack the resources to implement a program that would identify and audit high leaking homes and repair the leaks that are found before the 2020 water use targets must be met.

Conservatively estimating that, on a statewide average, water agencies were able to work with their residential customers so that just under half of this potential leakage could be detected and repaired, the savings would then be 3 GPCD.

Showers

Showers account for about 20-22% of indoor residential use, equivalent to about 11.8-13.5 GPCD.

A 2009 study4 found that nearly 80% of all homes had showerheads operating at 2.5 gpm or less (the flow rate for efficient shower heads). Savings in shower water use can be achieved by continued retrofit of inefficient shower heads and public education campaigns that include messages to take shorter showers.

The 20 x 2020 Plan estimates potential water savings remaining to be captured in shower water use is roughly 1 GPCD.

Faucets

Faucets account for about 19% of indoor use, approximately 11- 12 GPCD.

The maximum flow rate for new faucets, set by federal standards in 1994, is 2.5 gpm, though some faucets, especially bathroom faucets, can operate as low as .5 gpm. A 1999 study estimated there was 50% penetration of 2.2 gpm faucet aerators[3].

Savings in faucet water use can be achieved by continued retrofit with low flow fixtures and aerators and public education campaigns that include messages to “turn off the tap” when water is simply going down the drain.

The Single Family Water Use Study[4] assumes a reduction of 10% in faucet water use. (11.5 GPCD X 10% = 1 GPCD). This equates to a 1 GPCD savings.

Total Projected Savings for Indoor Residential

Adding the savings from each of the fixtures and appliances above, total projected water savings for indoor residential use is 15 GPCD. (Table 3-3)

PLACEHOLDER Table 3-3 Potential Savings for Indoor Residential Water Use (in GPCD)

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Citations

[1] EPA study of retrofit homes (2000)

[2] Waste Not Want Not, Pacific Institute

[3] AWWA study, Residential End Uses of Water 1997

[4] California Single Family Water use Efficiency Study (Single Family Water Use Study), 2011

[5] 20x2020 Plan

[6] California Water Plan Update 2009

Commercial/Industrial/Institutional (CII)

The CII sector covers a broad range of water uses, from schoolyard playgrounds and drinking faucets to bottling plants and restaurants. It is, therefore, a challenging sector to address, whether trying to make broad generalizations about CII water use as a whole or trying to drill down and find detailed data on any particular use. The State does not currently have the data necessary to establish the baseline of use in each CII sub-sector and the information needed to estimate statewide savings must await the development of the baselines and metrics.

The CII sector (not including large landscape) uses about 20% of urban water, which equates to 1.7 Million Acre Feet per year, or approximately 48 GPCD [1,2,3,5].

If water used for large landscapes is added to CII water use, the total CII water use would then be approximately 30% of urban water use. The 30% figure is often quoted for CII water use. However, water use for large landscapes will not be discussed in this section, as it has been addressed in the Landscape Water Use section, above. The CII landscapes with mixed use meters (indoor and outdoor use on one meter) are included in this section as they are distinctly different from large landscapes, such as parks and golf courses.

CII Task Force

In response to the complexity of the CII sector and the lack of data available on CII water use, the SBX 7-7 legislation called for a CII Task Force to address CII water use efficiency, including development of alternative best management practices and metrics for water use in CII sectors. The Task Force wrote a report of their findings and recommendations to the Legislature. The full CII Task Force report to the legislature can be found http://www.water.ca.gov/xxxxx [2]. [to be updated when report is complete]

CII Water Uses and Inefficiencies

There are limited centralized data concerning how much water is used in the CII sectors. Data on the numerous end uses is even more scattered. However, water uses within the CII sector can be grouped into the following common uses [2, 3]: process, restrooms, cooling, landscaping, kitchen, and laundry. With the exception of process water use, these end uses are very similar among CII users.

- Process. Process water inefficiencies include poorly adjusted equipment, leaks, use of outdated technology and/or equipment that are not water efficient, and use of potable water where recycled or re-used water may be adequate.
- Restrooms. Restrooms usage is one of the higher end uses in CII. Inefficiencies in this area are similar to those in the residential sector; these include older toilets with high volume flush rates and high volume faucets.
- Cooling. Water is used for cooling heated equipment, cooling towers, and air conditioning. Inefficiencies include improper adjustments made by system operators, system leaks, and the use of older, inefficient equipment.
- Landscape. Inefficiencies in CII landscape, as with other landscapes, include poorly designed and maintained irrigation systems, excessive watering schedules, and landscape designs that rely on high water using plants, especially cool season turf, where low water using plants could provide the same benefit while using less water use.
- Kitchen. The majority of the water used in the kitchens is for pre-rinsing, washing dishes and pots, making ice, food preparation, and equipment cleaning. Inefficiencies in kitchen water use include usage of old machineries, high volume spray valves, and cooking behaviors and techniques.
- Laundry. Water savings can be achieved through use of more efficient washers.

PLACEHOLDER Box 3-8 Process Water

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Water Recycling and Reuse in CII

The use of recycled water (treated municipal effluent), or the reuse of process water within an industrial facility can play an important part in reducing CII water demand. With appropriate management many non-potable water uses can be supplied with these alternate sources, such as cooling, washing, irrigation, and toilet flushing.

Recycled water provides 209,500 acre feet of fresh water a year to CII sectors, including power plants. Saline water use from coastal sources also provides additional water primarily to the mining and steam electric power plants, estimated at 14.5 MAF per year. [6]

Water reuse opportunities exist in almost all industrial plants and are a growing focus of industry. Water reuse can range from reusing relatively clean rinse water for initial washing processes to the capture of rainwater or air conditioning condensate for use in irrigation or a cooling tower.

CII Task Force Recommendations

The CII Task Force Draft Report makes the following recommendations for CII end users:

- Properly adjust equipment and fix leaks. Make adjustments and repairs to existing equipment and processes so that it operates more efficiently.
- Modify equipment or install water saving devices and controls. Add devices, automated systems, or equipment to existing water using equipment and processes.
- Replacement with more efficient equipment. Replacing older inefficient water using equipment and fixtures with water saving types of equipment is one of the most recognized ways to reduce water use. As better technology becomes available CII businesses may decide to upgrade their water using equipment, fixtures, and machines when they reach their useful life as a cost effective measure. Older equipment by its design uses more water, energy, chemical, and wastewater than newly designed equipment.
- Water reuse/recycling. Many case examples of water recycling can be found in the CII Task Force report and show the potential for using this non-potable water source. A thorough discussion of this is found in the Recycled Water RMS, Chapter X of the California Water Plan.
- Switch to a waterless process. A number of examples of replacing water using equipment with equipment that does not use water can be found in the BMPs of the CII Task Force report.

Water Agency Actions

Each water agency will face a unique blend of CII customers and will need to tailor the implementation of their CII water conservation program to fit local needs and opportunities. However, certain actions will assist water agencies in increasing CII water use efficiency to meet 2020 targets. These include: identifying the highest users of CII water within the agency and offering or otherwise supporting water use surveys for these customers, continued and more aggressive conversions of mixed use meters to dedicated landscape meters, and continued retrofit of older toilets to ULFT and HET.

PLACEHOLDER Box 3-9 California Prisons Reduced Annual Water Use by 21 Percent

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Projected CII Savings

Because of the lack of sufficient water use data for the CII sector, and the fact that water conservation potential varies greatly among technologies, industries, and regions, determining a value for projected savings is challenging.

However, the SBX 7-7 legislation and the CUWCC MOU both point to a savings in the CII sector of 10% from the baseline. In order to maintain consistency with the legislation and the MOU, DWR will also use the value of 10% to project CII water savings.

These potential CII water savings exclude savings from Large Landscapes, which are included in the landscape portion of this chapter.

The volume of potential savings in the CII Sector (AF) is derived by multiplying CII baseline water use (1.76 MAF) by the assumed 10% reduction (1.76 MAF x 10%). The resulting savings are 176,000 AF, which equates to 4.8 GPCD.

Citations

[1] California Water Plan 2009

[2] CII Task Force Report

[3] Waste Not, Want Not, Pacific Institute

[4] DWR Process Water Regulation

[5] 20 x 2020 Task Force

[6] State Water Resources Control Board (SWRCB) *2009 Municipal Wastewater Recycling Survey,*

References

AWWA Commercial and Institutional End Uses of Water, 2000

Industrial Water Reuse - Australia

Water Loss Control in Distribution Systems

This section addresses water loss due to leaks in the distribution system of a water supplier. Leaks in the residential and CII sectors are addressed in their respective sections of this chapter.

Water loss control consists of the auditing of water supplies and implementation of controls to keep system losses to a minimum. A report by Southern California Edison (2006)[1] estimated that 10% of the total volume of water supplied statewide is lost to leaks, which equals .88 Million Acre Feet. Addressing this loss is a major challenge to water suppliers, many of whom have aging water distribution systems in need of repair, yet they lack adequate funding for this work.

Audits

Water auditing is crucial to identifying the economically viable options that can be implemented for water loss control. Water utilities that do not perform water audits are most likely to be unaware of the level of real losses in their networks, making it unlikely for them to implement best management practices to curb these loss volumes.

A new standard method for conducting water audits was co-developed by The American Water Works Association (AWWA) and the International Water Association (IWA). The IWA/AWWA water audit method is effective because it features sound, consistent definitions for the major forms of water consumption and water loss encountered in drinking water utilities. It also features a set of rational performance indicators that evaluate utilities on system-specific attributes, such as the average pressure in the distribution system and total length of water mains.

The IWA/AWWA water audit method is detailed in AWWA's manual, Water Audits and Loss Control Programs (2009)[2]. AWWA also offers free software for this auditing method that assists in tracking water consumption and losses and calculates the costs of losses, giving agencies a sense of their system cost effectiveness.

This new standard water audit is now a requirement for implementation of BMP 1.2. All water agencies that are members of CUWCC, as well as any agencies that seek funding from the State of California, are obligated to complete the standard water audit annually and to reduce water losses to the extent that is cost-effective.

Trenchless Pipe Repairs

Repairing leaky pipes can be an expensive and difficult proposition for agencies. Trenchless pipe repair is an emerging, cost effective technology that offers an efficient alternative in pipe repair. Using this new technology the damaged pipe is lined with a new cured-in-place-pipe that seals all cracks, splits, and faulty joints. This trenchless technology requires no trenching or digging and can be done in much less time without large excavations, saving money, time, and labor, making repairs and maintenance more cost effective.

Projected Savings

A report by Southern California Edison (2006)[1] concluded that forty percent of water loss is economically recoverable. Given that the estimated water loss in California is 0.88 Million Acre Feet, and 40% of that is estimated to be economically recoverable, the calculated water savings from cost-effective water loss control is .35 Million Acre Feet, or 7 GPCD.

Citations

[1] Southern California Edison report (2006)

[2]American Water Works Association (AWWA) *M36, Water Audits and Loss Control Programs* (2009)

[3]website (http://www.awwa.org).

References

American Water Works Association. "Buried No Longer: Confronting America's Water Infrastructure Challenge".

CUWCC. AMI Symposium. Dec 2011.

Combined Demand Reductions

Combining the estimated demand reductions from each sector, as detailed in the preceding paragraphs, the state of California could theoretically reduce demand for potable water in the year 2020 by 2 Million Acre Feet.

This represents a statewide overview and is not intended as a blueprint for individual water agencies, as each agency will have their own unique strategy for achieving the 20% reduction. (Table 3-4).

PLACEHOLDER Table 3-4 [Title Needed]

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Alternative Water Sources — Recycled Water, Desalinated Water, Gray Water, Rainwater

Alternative water supplies (recycled, desalinated, stormwater) are expected to further reduce statewide demand of potable water by the year 2020. [This text should be updated as estimates become available in 2013 CA Water Plan.]

Taken as a whole, alternative water sources may have a significant effect on the amount of potable water saved statewide. Alternative water sources vary in water quality, level of treatment, local availability and suitability for intended uses.

Recycled water and desalinated water undergo the highest level of treatment prior to use and are discussed in detail in chapters [xx and xx]. [RECYCLED WATER – waiting for narrative from Toni.]

Residential rainwater capture and gray water reuse are sources of water that can be utilized without the high investment in infrastructure that recycled or desalinated water require.

Rainwater capture is discussed at length in Chapter 19, Urban Runoff Management, but it should be mentioned here that on-site rainwater capture, in the form of rain gardens, bioswales, pervious surfaces and other landscape features, can reduce the amount of potable water needed for irrigation by shortening the irrigation season through replenishing soil moisture levels. A small to moderate sized rain garden can collect thousands of gallons of water. For example, a demonstration rain garden at the Richardson Bay Audubon Center, Marin County, can collect nearly 3900 gallons of water in a 315 sq, ft. rain garden with approximately 22” annual rainfall[1].

Although there is tremendous interest in rainwater capture with rain barrels and cisterns, California’s dry summer climate brings into question the cost effectiveness of small rain capture devices in many regions of the State. However cisterns and other large volume storage devices begin to become cost effective in areas where the rainy season extends into the irrigation season, or where supplied water is very expensive, unreliable or difficult to convey.[2] Unlike rainwater capture for irrigation in which supply availability and demand are out of sync, rainwater capture for year round indoor non-potable uses, such as toilet flushing may be the most practical application[3] Rainwater standards are printed in Chapter 17 of the 2013 California Plumbing Code. [note to WP staff-Ch 17 is a proposed chapter at this time]

During the 2013 triennial code cycle gray water standards were revised by California Building Standards Commission (CBSC) and Department of Housing and Community Development (HCD) and organized in Chapter 16 of the California Plumbing Code. Gray water use will increase over time, partly due to changes in the gray water standards. The revised standards make it easier for a water user to install a gray water system; simple systems supplied by clothes washers or single fixtures do not require a building permit if certain conditions are met.

In the City's 2010 Urban Water Management Plan (UWMP) [3], the Los Angeles Department of Water and Power features a case study of alternative water use by one of its residential customers. In addition to collecting rainwater in 18 rain barrels, the customer installed a gray water system using the waste water from her clothes washer. The clothes washer supplied gray water system generates approximately 7,000 gallons of water per year by the family of three. By adding the shower and bathroom sink to the gray water system, the water generated for landscape irrigation could exceed 53,000 gallons of gray water per year. The California Single Family Home Water Use Efficiency Study found that the annual estimated irrigation demand averages about 90,000 gallons per year at the homes studied. Based on this assumption, this family could offset nearly 60% of their irrigation demand by the expanded gray water system. Under the new gray water standards the City does not require a plumbing permit if the plumbing is not altered and health and safety conditions are met.

Alternative water source references:

[1,2] 10,000 Rain Gardens Project

[3] Rainwater Harvesting in San Francisco

[4] LADWP 20102 UWMP

The Importance of Conservation Rate Structures

Conservation rate structures are rates set by water agencies to provide price signals to consumers and encourage water conservation. The use of conservation rate structures will help water suppliers curb demand and meet their 2020 targets.

Conservation rates are also known as volumetric rates because the customer bill reflects the volume of water used. These structures can be applied to water supply as well as wastewater (sewer) services.

Some examples of effective conservation rate structures include;

- Increasing block tier structures. The cost per unit of water increase as the consumer uses more water.
- Water budget structures. Each residence has an inclining block rate structure designed according to the number of occupants, landscape area, local climate and possibly other factors. The prices of the tiers increase significantly after the base usage tier has been reached.

- Water budgets with punitive tiers when budgets are exceeded. Often the revenue generated from punitive tiers is used to fund the conservation programs.

Flat rates, where customers' bills do not reflect the volume of water used, are not considered conservation rates because they do not send a price signal to the consumer and do not encourage conservation.

PLACEHOLDER Box 3-10 Successful Conservation Rate Structure: Irvine Ranch Water District

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the chapter.]

Conservation Rate Structures for Wastewater Services

Although roughly 90 percent of California households served by a public water supplier pay for drinking water through a volumetric rate, about 70 percent of such California households pay for sewer service through a flat non-volumetric charge. With sewer charges equal to or greater than water charges in most jurisdictions, the price signal rewarding water efficiency is being cut in half for a majority of California households. Water efficiency can reduce future infrastructure requirements for sewer service, and volumetric pricing for sewer service is encouraged by the U.S. Environmental Protection Agency, the Water Environment Federation, and the California Urban Water Conservation Council (CUWCC).

Installation of new hardware is generally not required to begin volumetric billing for wastewater, but where water and sewer are provided by different agencies, interagency cooperation is needed and billing software modifications are likely[1]. A 2011 report[2] presented a 3.5 % to 4.5% reduction in residential use with a 10% rate increase.

Rate Structure Citations

[1] Chesnutt, Bamezai, Hanemann. Revenue instability induced by conservation rate structures: an empirical investigation of coping strategies. February 1994.

[2] A&N Services Inc. Volumetric Pricing for Sanitary Sewer Service in the State of California. February 2011.

References

AWWA. Water budgets and rate structures: Innovative management tools. May 2008.

Designing, Evaluating, and Implementing Conservation Rate Structures, CUWCC 1997

Alliance for Water Efficiency Website www.allianceforwaterefficiency.org July 2012

Department of Agricultural and Resource Economics and Policy. Division of Agriculture and Natural Resources. University of California, Berkeley. Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies.

A & N Technical Service, Inc. Revenue Effects of Conservation Programs: The Case of Lost Revenue

A & N Technical Service, Inc., 2011, Volumetric Pricing for Sanitary Sewer Service in the State of California

Challenges to Urban Water Use Efficiency

Reduced Water Agency Revenue for Water Conservation

Because of the economic downturn, many water agencies have reduced their staff and other expenditures for water conservation. This reduction comes at a difficult time, when water agencies will need to increase, or at least maintain, the level of conservation in their districts in order to meet the 20% reduction by 2020.

Rate Structures and Water Agency Revenue

Providing customers with correct price signals to use water efficiently is not a simple task. The appropriate signals may vary from agency to agency and from community to community. And if the price structure is not set up correctly, the resulting water conservation can negatively affect the amount of revenue collected by a water supplier. The less water the customers use, the less revenue received, creating a disincentive for the water agency to encourage conservation. Also, because of seasonal variation in water use, some price structures may increase variability and fluctuation of water utility revenues.

This problem poses a hardship on the utility's ability to meet its revenue requirements, and can undermine the financial viability of their systems and the ability to meet service needs and infrastructure maintenance[2].

The process for changing rate structures requires public support and can be difficult to gain, especially during the economic downturn.

Implementing wastewater conservation price structures will require the cooperation of wastewater utilities. Volumetric wastewater pricing requires access to metered water consumption records and the ability to generate a customer bill. Sewer agencies currently billing fixed charges on a combined water-wastewater bill would have the fewest implementation constraints. Sewer agencies whose service area cuts across multiple water agency service area boundaries would face more implementation challenges.

Lack of Public Awareness Regarding Landscape Water Use

Most homeowners are not aware that the majority of their water use takes place in the landscape, nor are they aware that much of that irrigation water is used inefficiently. In the 2007 Statewide Marketing Survey: Landscape Water Use Efficiency[9], the researchers found that most respondents either had no idea how much water they used in their landscapes, or they believed their water use was below the statewide average. Coupled with the tendency to leave irrigation controllers on the default setting year round and lack of irrigation system maintenance, a statewide education campaign is needed to educate water users and increase awareness of meaningful actions that will save water in landscapes.

Landscape Area Measurement for Water Budgets

Knowing the area of a landscape is critical to developing a water budget for the site. A water budget, in turn, will assist in determining whether or not the landscape is being watered efficiently.

Many water suppliers have not determined the extent of landscape area in their service area. Impediments to measuring or estimating landscape area include the high cost of physically measuring the site or purchasing satellite imagery, lack of expertise in utilizing available satellite data, linking the parcels with customer data, segregating areas served by multiple meters, and assessing the density of vegetated canopies.

Data on Industrial Water Use is Limited

The last survey published by DWR to obtain valid information on industrial water use was conducted in 1979 (Bulletin 124-3). This information is out of date, but no current data exists. The survey determined rates of industrial water use (including both water agency and self-supplied water sources), quantities of water recycled by industry, and quantities of waste water discharged by industry.

Water Loss

The amount of water lost due to leakage in the distribution system of the state's water suppliers is not well known. This is largely due to the fact that not all water suppliers perform regular water loss audits. If water audits are not conducted, it is difficult for a water agency to know the extent of their losses and unlikely that they will implement best management practices to reduce these losses.

Lack of a Standardized Efficiency Measure for California Urban Water Suppliers

One of the limitations to the development of the 20x2020 goal was the lack of an effective measure of the level of water use efficiency in a supplier's service area. GPCD is useful to track changes in water use in individual water agencies over time, but due to difference in landscape area, climate and CII water use it is not useful as measure of efficiency. The lack of a standard measure of supplier efficiency is one reason 4 different methods for setting 2020 water use target were provided in the SBx7-7 legislation.

Recommendations

Assist Utilities in Developing Cost Effective Conservation Rate Structures

DWR in partnership with CUWCC and water agencies should lead an investigation to analyze and evaluate the effectiveness of rate structures in use by various water supply and wastewater agencies. DWR should disseminate the findings and recommendations from the study, as well as guidance to water agencies, throughout the state by way of regional workshops and a detailed page on the DWR Website.

Expand the Save Our Water (SOW) Campaign

DWR, in coordination with ACWA, CUWCC, water suppliers, local stakeholders and irrigation manufacturers should expand the statewide Save Our Water campaign. Initially the landscape portion of the campaign should focus on cost effective ways to improve irrigation system function and irrigation controller programming.

Assist Water Agencies in Landscape Area Measurement and Water Budgets

DWR in coordination with the CUWCC should assist water suppliers in finding easy and inexpensive ways to obtain landscape area data for parcels in their service areas and offer workshops that highlight successful programs.

As a priority, water agencies should measure the landscape area for sites with dedicated meters first, because their landscape water use is known. A comparison of water use and water budget will immediately determine if the landscape is being watered efficiently. Water agencies can then target the sites that are over-irrigating, a cost effective method for reducing landscape irrigation demand.

Increase Water Management Skills

Water use efficiency is most easily achieved on landscapes with properly designed and installed irrigation systems and managed with water budgets. To make this possible, the Contractors State License Board (CSLB) should increase the emphasis and testing requirements in the C-27 Landscape Contractor's exam in the subject areas of irrigation design and installation and water budgeting to ensure landscape professionals have the needed skills.

Update the Model Water Efficient Landscape Ordinance

DWR should work with local agencies and the landscape industry to remove barriers to implementation of the Model Water Efficient Landscape Ordinance (MWELO). The MWELO should be updated periodically based on new findings, innovation and technological improvements.

Update the Survey of Industrial Water Use

Because the last published survey on industrial water us in California was conducted in 1979 and updated data is needed by local agencies and the state in order to better manage industrial water use, DWR should update the survey of industrial water use, Bulletin 124-3. The survey should provide information on the rates of industrial water use (including both water agency and self-supplied water sources), quantities of water recycled by industry, and quantities of waste water discharged by industry.

Require Water Audits in 2015 UWMPs

In order to reduce water loss in water distribution systems, the legislature should revise the Urban Water Management Planning Act to require water suppliers to complete the American Water Works Association (AWWA) auditing program, and report their water audit, water balance, and performance indicator in their 2015 Urban Water Management Plans. Signatories to the CUWCC MOU are already required to perform this audit annually.

More on the AWWA auditing program can be found at http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=48055&navItemNumber=48162

Develop a Standardized Efficiency Measure for California Urban Water Suppliers

DWR through a public process should develop a standardized water use efficiency measure for California urban water suppliers. The measure would be used to determine efficient water use for urban water suppliers and would account for differences in irrigated landscape area, climate, population and CII water use. The single standardized measure for supplier water use efficiency would better permit customers, utilities and state officials to evaluate the efficiencies California Urban Water Suppliers across the state.

Investigate Gray Water Use in New Residential Applications

In cooperation with water suppliers and developers, DWR should conduct a pilot study of gray water installation in new homes. The study should evaluate gray water use in landscapes and the feasibility of installing gray water systems in new homes.

References

[References cited, additional references, and personal communications will be moved from the various sections and compiled at the end of the chapter in the next draft.]

References Cited

Additional References

Personal Communications

Table 3-1 Best Management Practices

Foundational BMPs (Ongoing practices implemented by all signatories to the MOU)		Programmatic BMPs (Practices with alternatives for implementation)	
BMP No.	**Description**	**BMP No.**	**Description**
BMP 1.1 Utility Operations – Operations	Designate a water conservation coordinator for the agency. Implement and maintain a water waste prohibition ordinance. Implement prohibitions on gutter flooding, single-pass cooling systems, non-recirculating water. Monitor water softener efficiency and usage *Old BMP Numbers 10, 12, and 13*	BMP 3 Residential	Conduct indoor and outdoor residential water use surveys. Implement an enforceable ordinance to replace high-flow water use fixtures with low-flow counterparts. Offer rebates for high-efficiency washers. Offer rebates for high-efficient, low-flow toilets. *Old BMP Numbers 1, 2, 6 and 14*
BMP 1.2 Utility Operations – Water Loss Control	Implement a full-scale system water audit, maintain in-house records of audit results or completed AWWA audit worksheets. *Old BMP Number 3*	BMP 4 Commercial, Industrial, and Institutional	Rank commercial, industrial, and institutional customers according to use. Implement either CII Water Use Survey and customer incentives program, or CII conservation program targets. *Old BMP Number 9*
BMP 1.3 Utility Operations – Metering	Install water meters for all new connections and bill by volume-of-use. Implement program for retrofitting existing unmetered connections and bill by volume-of-use. *Old BMP Number 4.*	BMP 5 Landscape	Develop marketing and targeting strategies for landscape surveys. Implement water use budgets for large landscapes. *Old BMP Number 5.*
BMP 1.4 Utility Operations – Pricing	Implement rate structures and volumetric rates for water service by customer class. *Old BMP Number 11.*		
BMP 2 Education – Information Programs	Maintain an active public information program about water conservation. Implement a school information program to promote water conservation. *Old BMP Numbers 7 and 8*		

Table 3-2 Statewide Urban Water Uses

Sector	Percentage	Volume
Large landscape	10%	0.9 MAF
Commercial/institutional	13%	1.1 MAF
Industrial	7%	0.6 MAF
Residential interior	31%	2.7 MAF
Residential exterior	35%	3.0 MAF
Other	5%	0.5 MAF
Total	**100%**	**8.8 MAF**

Source: California Water Plan Update 2009.

Table 3-3 Potential Savings for Indoor Residential Water Use (in GPCD)

Use	Savings
Toilets	5 gpcd
Showers	1 gpcd
Leaks	3 gpcd
Faucets	1 gpcd
Clothes washers	4-6 gpcd
Total	15 GPCD

Table 3-4 [Title Needed]

Demand reduction sectors	GPCD reduction	Projected savings in 2020 (AF)
Large landscape	3	148,000
CII	4	197,000
Residential interior	15	739,000
Residential exterior	16	789,000
Water loss control	7	345,000
Total	45	2,218,000

Figure 3-1 Average Regional Baseline Water

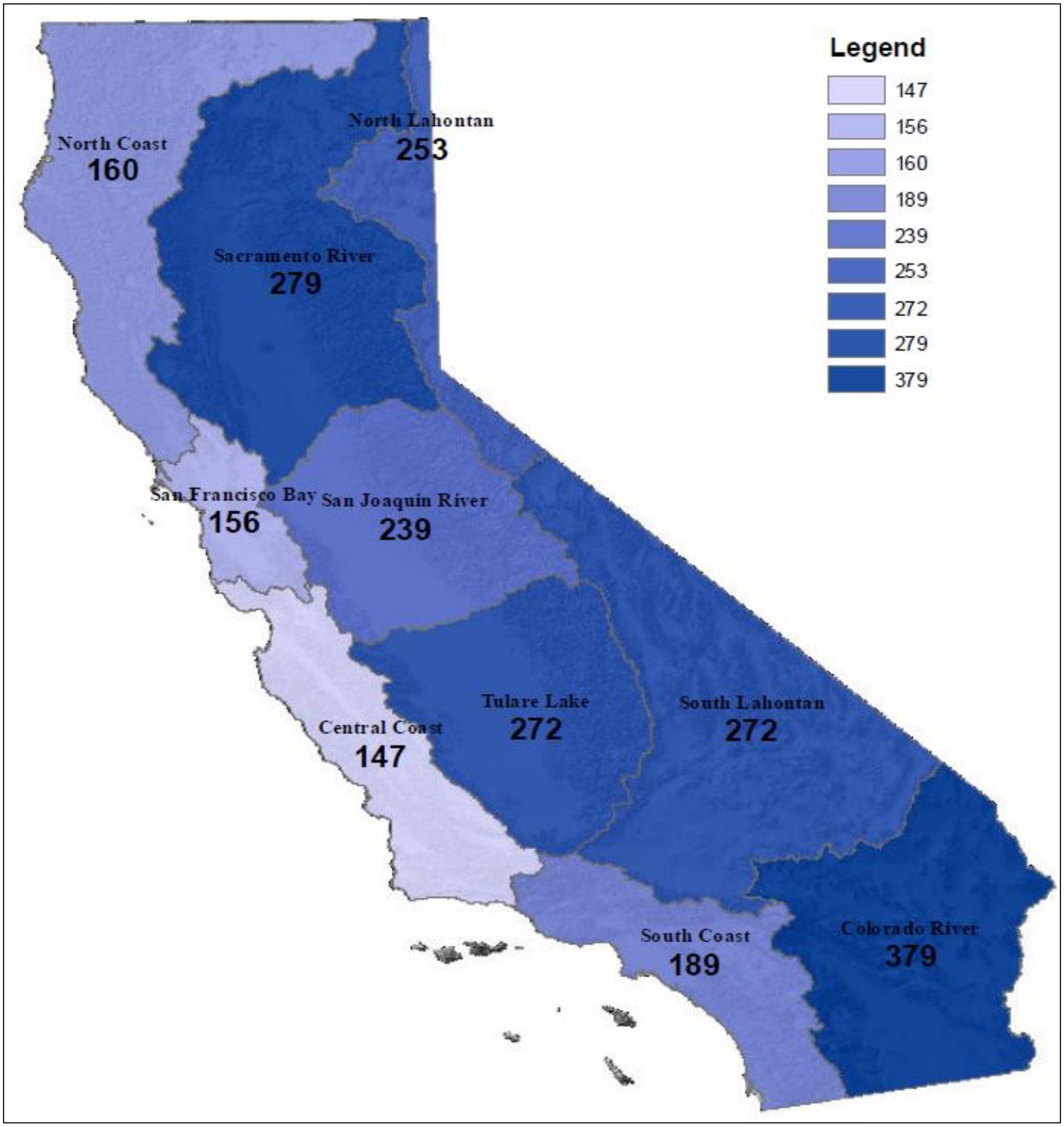


Figure 3-2 Range of Baseline Water Use Reported by Urban Water Suppliers

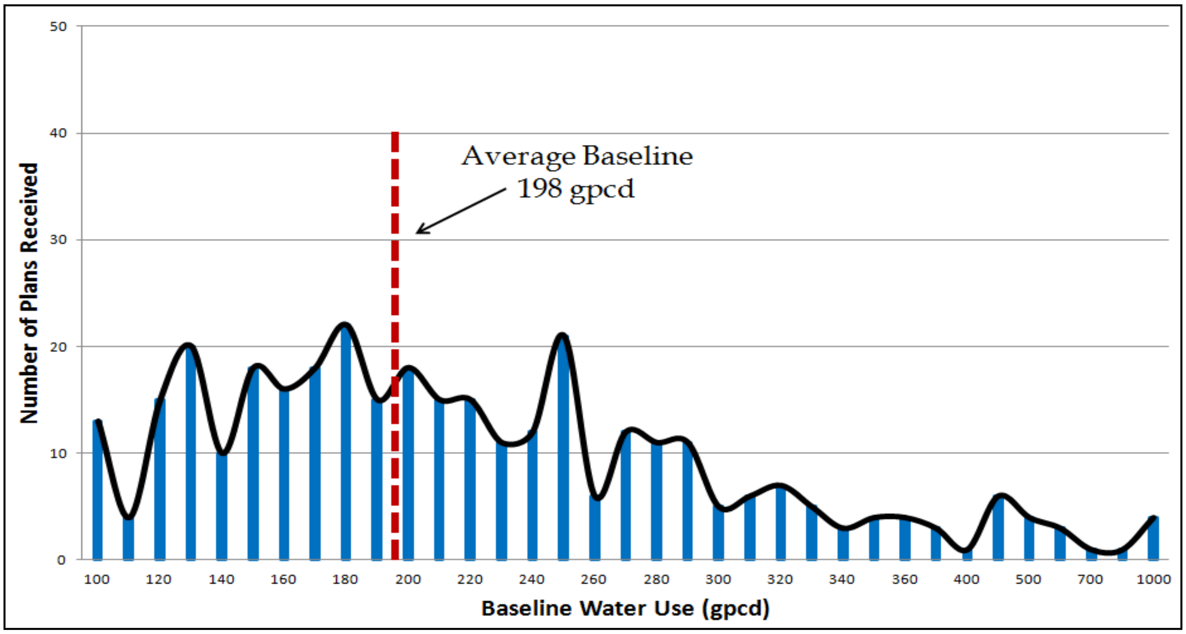
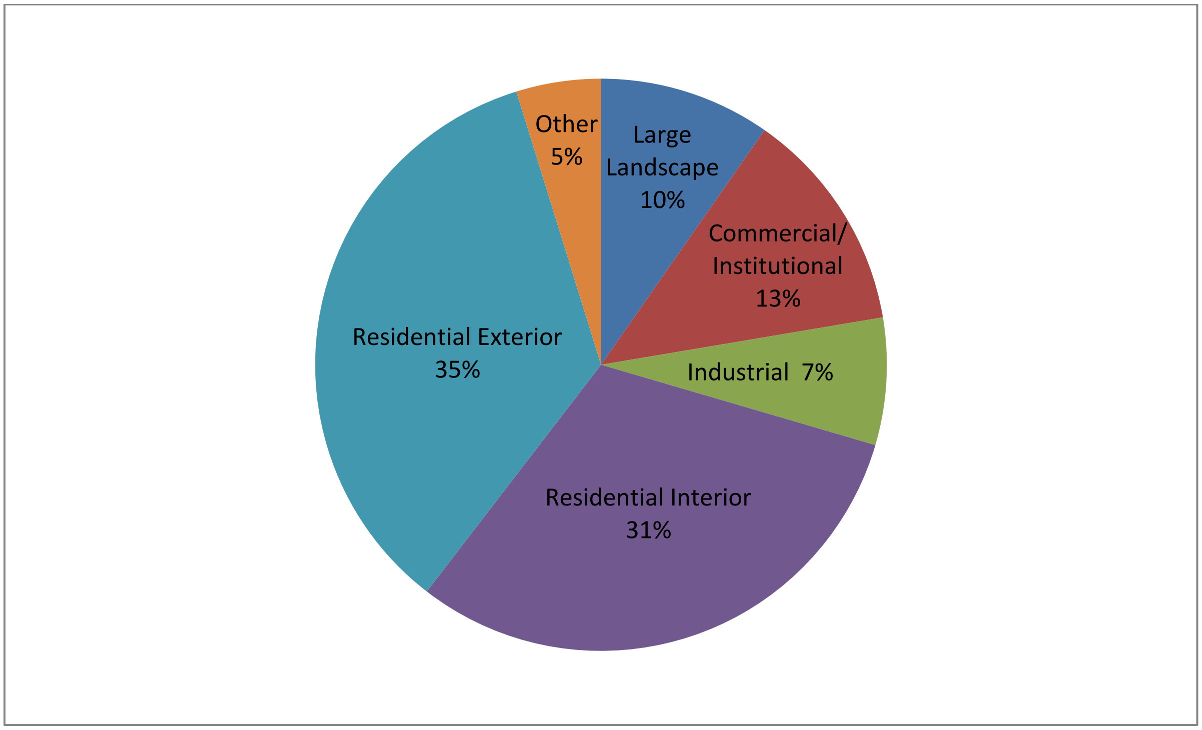
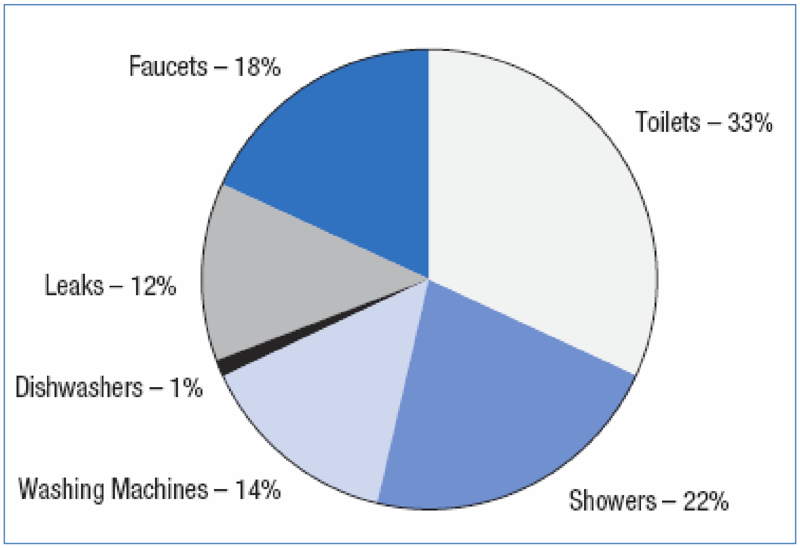


Figure 3-3 Urban Water Use Statewide Average



This pie chart illustrates the relative water use of different sectors as a statewide average. The water use by sector will vary for each individual water agency. Source: *California Water Plan Update 2009*

Figure 3-4 Estimated Current Indoor Residential Water Use in California (Year 2000)



Source: *Waste Not Want Not*

Box 3-1 Reducing Irrigation Runoff Helps Local Waterways

Improving irrigation efficiency will prevent irrigation runoff, saving both water and energy and preventing the contamination of receiving waters by landscape pesticides, fertilizers, pet wastes, and sediment.

Sampling of the water quality in urban streams throughout California has found the universal presence of common landscape pesticides such as diazinon, fipronil, chlorpyrifos, and bifenthrin among others. When excess irrigation water is applied, pesticides, herbicides, fertilizers, other nutrients and pathogenic organisms are washed into the stormwater system and local watersheds. These contaminants are toxic to aquatic organisms.

Dry season irrigation runoff can be prevented by irrigation system maintenance, proper irrigation scheduling, and landscape design. Irrigation scheduling should be appropriate for the site conditions, factoring in slope, soil type and the ability of the soil to absorb the water. Incorporation of rain gardens and vegetated swales into a landscape design will also retain runoff from irrigation and rainwater, reducing negative impacts to local waterways.

Box 3-2 Climate Change and Water Use Efficiency: The Energy-Water Nexus

The state's energy and water resources are entwined. Energy is used to transport, pump, heat, cool, treat, and recycle water. And water is used to generate hydro-electricity and to cool power plants.

According to the California Energy Commission's (CEC) California's Water- Energy Relationship (2005) report (California Energy Commission 2005), water-related energy use consumes about 19 percent of the state's electricity, 88 billion gallons of diesel fuel, and 30 percent of natural gases. Urban water use comprises 58% of the total water-related energy consumption in the state.

When water is used efficiently, there is a corresponding savings in energy. And because most energy production creates greenhouse gases that contribute to climate change, water use efficiency is a method for mitigating climate change.

In 2004 CUWCC members who implemented the Council's BMPs reported a savings of 27 billion gallons of water. This significant water savings also saved more than 234 million kWh of electricity, and an estimated $200 million in energy costs.

Source cited: California Energy Commission. 2005. California's Water-Energy Relationship. November.

References

NRDC. "Energy Down The Drain: The Hidden Costs of California's Water Supply". August 2004.

California Public Utilities Commission. http://docs.cpuc.ca.gov

[The references here will be moved to the "References" section of the chapter for later drafts.]

Box 3-3 San Diego's Water Sources: Assessing the Options

A 2010 study comparing the marginal costs of seven alternative water solutions for San Diego concluded that conservation was the most favorable and least costly option.

Table A Cost per Acre Foot by Water Source

Water Source	Cost per Acre Foot
Imported	$875-$975
Surface Water	$400-$800
Groundwater	$375-$1100
Desalinated	$1800-$2800
Recycled	$1200-$2600
Conservation	$150-$1000

These costs were determined for the San Diego area and will vary for each individual water agency.

From San Diego's Water Sources: Assessing the Options, Equinox Center, 2010

Box 3-4 Landscape Irrigation Runoff

Photo A shows an example of irrigation runoff, frequently seen in landscapes throughout the state of California.

Fortunately, many opportunities exist to improve efficiency in landscape irrigation. These include the use of Evapo-Transpiration (ET) controllers, reduction of cool season turf, and education of water users.

A study conducted in 2004 by MWDOC and Irvine Ranch Irrigation District, *The Residential Runoff Reduction Study,* demonstrated that a combination of ET controllers and user education can greatly reduce dry season irrigation runoff.

In this study, dry season irrigation runoff was measured from 138 residential and non-residential landscapes. After the runoff was measured, the landscapes were retrofitted with ET controllers and the water users were educated in efficient irrigation practices. A second set of runoff measurements were taken after the retrofit and user education.

A comparison of the first and second measurements showed that irrigation run off had been reduced 50% by the installation of ET controllers and user education.

PLACEHOLDER Photo A Irrigation Runoff

[For the advisory committee draft, the draft photo follows this box.]

Box 3-4 Photo A Irrigation Runoff

Box 3-5 The Value of Landscape Water Budgets

Landscape water budgeting is a straightforward method for determining if a site is receiving the correct amount of water to keep the plants healthy without wasting water. A water budget is calculated using local reference evapotranspiration data (ETo), an evapotranspiration adjustment factor (ETAF) and the area in square feet of the irrigated landscape. The landscape area can be captured from landscape plans, measuring the site or aerial imagery. Historically, obtaining the landscape area has been a challenge for water suppliers, especially when more than one meter may serve a parcel, but new tools and technology are becoming available that will simplify the process.

When the volume of water allowed in the water budget is compared to water use data, the irrigation manager can evaluate if water use is on track and if not, can make immediate changes to the irrigation schedule. Because weather conditions influence the water needs of plants, irrigation managers should assess compliance with the water budget weekly or at least monthly.

Water budgets are valuable communication tools. An irrigator that keeps a site within a water budget can show their customer the water savings and cost savings achieved compared to historical use. Water suppliers can assign a water budget to an account and notify the customer when the budget is exceeded. Water budget-based tiered rates send a pricing signal that discourages wasteful water use.

Box 3-6 Dedicated Water Meters: Water Code 535

Since 2008, water suppliers must install a dedicated landscape meter on new non-residential water service with a landscape area over 5000 sq. ft. The Cal Green Building Code requires dedicated meters, metering devices, or sub-meters to facilitate water management on non-residential landscapes from 1000 sq. ft. up to 5000 sq. ft.

Box 3-7 City of Sacramento Case Study — Advanced Metering Infrastructure (AMI)

After installing AMI in over 17,600 residences, the city of Sacramento reported the following successes during the two year period of 2010-2011:

- 1,076 single family homes showed leak alerts
- 75% of leaks were verified in the field
- 367 million gallons of aggregate annual water loss was calculated through AMI reports
- 236 million gallons of water were saved, which equates to 12.6 GPCD

AMI can play a major component in helping the City of Sacramento reach the State mandate of 20% per capita reduction by 2020.

As presented at the CUWCC AMI Symposium, Sacramento 2011.

Box 3-8 Process Water

Process water is water used by industrial water users for producing a product or product content or water used for research and development. Process water is highly specific to each industrial user.

Process water, within certain parameters, may be excluded from calculations of baselines and targets in order to avoid a disproportionate burden on another customer sector.

Source: DWR Process Water Regulation

Box 3-9 California Prisons Reduced Annual Water Use by 21 Percent

By implementing a water conservation program, the California Department of Corrections and Rehabilitation (CDCR) achieved an annual water use reduction of 21 percent. CDCRs water conservation program began in 2006, ramped up in 2008 in response to the drought declaration, and achieved a 21% reduction by 2009.

CDCR headquarters issued a “Best Management Practices Water Management & Conservation” document that covered:

- Eliminating nonessential water use
- Water efficient landscaping and irrigation
- Leak detection and repair
- Laundries and vehicle washing
- On-site water consumption surveys

CDCR enacted the following measures:

- Toilet flush meters were installed in nearly one-third of all adult institutions.
- Institutions report monthly water consumption to CDCR headquarters
- Enacted low-or-no-cost water conservation methods

Source: California Department of Corrections and Rehabilitation, April 3, 2009

Box 3-10 Successful Conservation Rate Structure: Irvine Ranch Water District

The rate structure at the Irvine Ranch Water District (IRWD) signals customers when they are exceeding their water budget and signals IRWD which customers are in need of attention.

IRWD sets water budgets for each customer based on a variety of factors, such as the size of their landscape area, weather, number of residents, or the industrial or commercial business types. When a customer exceeds their water budget, the price per unit of water becomes more expensive. By taking these factors into consideration, IRWD is able to customize the water budget for each customer and ensure a fair allocation.

IRWD also charges a monthly fixed charge based upon meter size. The fixed charge covers all operating costs and related water use efficiency programs. IRWD operates with a stable revenue stream despite variability in the volume of water sold.